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U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1643

FIRE SAFEGUARDS FOR THE FARM

THIS BULLETIN tells how to avoid or lessen the fire hazards on the farm and thereby add to the safety of property as well as persons. It points out how the individual farmer can further reduce the probability of serious fire losses by means of simple home equipment with which a fire that is discovered in its beginning stage can be quickly extinguished. Finally, it points out the need for organized and well-equipped rural fire departments and tells how this need has been met in many rural communities. Such organized protection is necessary for the farmer in order to hold the loss to a minimum whenever a fire gets a threatening start.

Reasonable care and forethought in the removal of needless fire dangers, a fair degree of individual preparedness, and the availability of community fire protection will greatly reduce the present fire losses on American farms, which now total about $100,000,000 per year. Substantial reduction in the number and destructiveness of farm fires, which often destroy human life as well as property, will eliminate much unnecessary hardship and sorrow and will help to promote rural progress and well-being.

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FIRE SAFEGUARDS FOR THE FARM

By V. N. VALGREN, *Senior Agricultural Economist, Division of Agricultural Finance, Bureau of Agricultural Economics;* HARRY E. ROETHE, *Engineer, Chemical Engineering Division, Chemical and Technological Research, Bureau of Chemistry and Soils;* and M. C. BETTS, *Senior Architect, Division of Agricultural Engineering, Bureau of Public Roads*

CONTENTS

	Page
Introduction	1
Elimination of fire danger	3
Construction and maintenance	3
Hazards and dangers from carelessness	8
Home fire-fighting equipment	13
Ladders	13
Fire pails and barrels	14
Home fire-fighting equipment—Contd.	
Water under pressure	15
Chemical extinguishers	15
Community fire protection	18
Rural fire trucks	20
Laws encouraging organized rural fire protection	21
Conclusions	22

INTRODUCTION

THREE KINDS or classes of safeguards are required to make farm property reasonably safe from fire. By the proper application of these safeguards the annual farm fire loss could be reduced by $50,000,000 or more. Even this reduction would merely cut in half the present annual loss of about $100,000,000. Students of fire prevention and protection are generally agreed that considerably more than half of the farm fires that occurred last year or in earlier years, could readily have been prevented. The further fact that accidental fires, both on the farm and in the city, frequently destroy human life as well as property makes the problem of fire safety doubly important.

The first of these safeguards is the exercise of care and forethought in the construction, maintenance, and use of the property, with a view to eliminating, so far as possible, all needless fire danger. The second is individual or home preparedness in the form of simple equipment for use in extinguishing fires before they reach serious proportions. The third is community preparedness, consisting of a fire-fighting organization equipped to check larger fires or to prevent their spread to buildings other than those in which the fires originate. Such an organization, with more effective equipment than the individual farmer can maintain, is needed to hold the loss to a minimum in those cases in which the first two classes of safeguards have failed or threaten to fail.

These three classes of safeguards together make a triple line of defense against destruction by fire, each class supplementing the other two. The order in which they have been given may be said to be the order of their importance as well as the order in which they should be applied. The first class of safeguards really consists of means and methods of avoiding fire danger, and constitutes fire prevention.

The second and third are means and methods of fire fighting, or fire protection as it is usually called.

Without the exercise of care and forethought in prevention, fires are likely to occur so frequently and to spread so quickly that no form of protection will prevent serious losses. Without individual preparedness by means of simple fire-fighting equipment, most of the fires that do occur are likely to result in serious losses. Without community equipment and organization, a fire that is not promptly stopped by the use of home equipment is likely to destroy not only the building in which it originates but near-by buildings and other property.

If the first and second of these sets of safeguards, or either of them, could be made perfect, the need for the third—organized or community fire protection—would disappear. But such perfection never has been reached, in America or elsewhere. Furthermore, it is admitted that complete fire safety by individual action or even by combined individual and community action is probably an unattainable goal.

Reasonable preventive measures, and reasonable preparedness against such fires as may occur, are all that can properly be recommended or practiced. Beyond such rational limits, measures for fire prevention and protection become unduly costly or burdensome. No one would recommend, for example, that heat and light be dispensed with in the home because they can not be made absolutely free from danger of fire, or that fire-fighting forces and equipment should be maintained by farmers on the same elaborate scale that prevails in congested and high-value city districts. With moderate and practical preventive measures the probability of serious loss by fire to the individual farmer can be greatly reduced. In fact, property and persons can be made reasonably safe against loss or destruction by fire without resorting to extreme measures, and when these reasonable precautions have been taken by a community, insurance against such infrequent losses as may occur should be obtainable at very moderate cost.

But how many farms or how many rural communities in the United States are now safeguarded against fire to a reasonable degree? The cost of fire insurance in many parts of the country and the estimates of our total farm fire loss give a rather distressing reply. No complete or highly reliable figures for our annual farm fire losses are available. Private estimates vary from $60,000,000 to $150,000,000. Such official reports and figures as are available suggest that an estimate of $100,000,000 would come fairly close to the actual losses of farm property as distinguished from the broader concept of rural property. This estimate was recently approved by the committee on farm fire protection of the National Fire Protection Association.

Commercial farm-insurance rates for limited sections of the country reach $2 per $100 per year under certain conditions. Even for sections or States in which fire insurance in farmers' mutual companies can be obtained at an average cost of about 20 cents per $100 per year and in which commercial rates are only a little higher, there is good reason to believe that the farm fire losses are fully twice what they would be if moderate and rational safeguards against fire

were employed by all farmers. Here, as in districts less fortunate from a fire-loss standpoint, the added personal safety and the removal of much of the worry and privation that accidental fires usually bring in addition to the direct fire loss, would represent as important gains as would the savings from a reduced cost of insurance.

ELIMINATION OF FIRE DANGER

In the first class of safeguards, or measures for the elimination of fire danger, the questions and problems involve considerations of safe construction, proper maintenance, and due caution in the use of heating, lighting, and other equipment and materials that involve danger to property and life.

CONSTRUCTION AND MAINTENANCE

Location of building.—The first question in connection with the construction of a building is the location of the building with reference to other buildings on the farmstead. The barn, or barns, in which hay and straw are stored and used, and about which some litter is at times unavoidable, should normally be separated from the dwelling wherein fire is regularly used, by a distance of at least 100 feet. A clear space of 150 feet is held to give practical security from exposure fires. Where other considerations make such spacing of the buildings impossible or inadvisable, special consideration should be given to other protective measures, such as the use of noncombustible or fire-resistant construction materials, by means of which the hazards due to proximity of these buildings to one another can be partially offset.

Another important consideration is that of so placing the main buildings, particularly the dwelling and the barn, that the prevailing winds in the locality blow at right angles to a line connecting these buildings, rather than parallel to such a line. If the dwelling and barn are so placed that the prevailing winds blow along the line connecting them, the fire hazard is materially increased. With a strong wind blowing from the dwelling to the barn, there is the danger, not only that the burning of the dwelling will seriously endanger the barn, but also that on some dry and windy day sparks from the dwelling-house chimney may set fire to the barn. With the wind blowing from the barn to the dwelling, the main danger is that if the barn should burn, the dwelling would be seriously endangered by the strong heat and the flying sparks that are particularly characteristic of a barn fire. The result might be a disaster such as that pictured in Figure 1. In addition to the fire hazard involved, a farm layout in which the prevailing winds blow from the barn or the hoghouse to the dwelling, has the objection that the dwelling will be needlessly subjected to disagreeable farmyard odors.

In few, if any, localities is the wind movement consistently from any one direction, or along a given line. Regardless of how the buildings are placed with reference to one another the wind direction at times, will be either directly from the dwelling to the barn or from the barn to the dwelling. In practically all sections, however, there is a prevailing wind direction. To ignore this fact is to

increase unnecessarily the danger of serious loss from fire and to incur other unnecessary discomfort. In a given locality, for example, the prevailing winds may be from the northwest to the southeast,

FIGURE 1.—Farm fires often leave only ashes and scrap iron

or the reverse of this direction, fully three-fourths of the time. In such a locality the farm layout, if possible, should be such that the barn is either northeast or southwest of the dwelling.

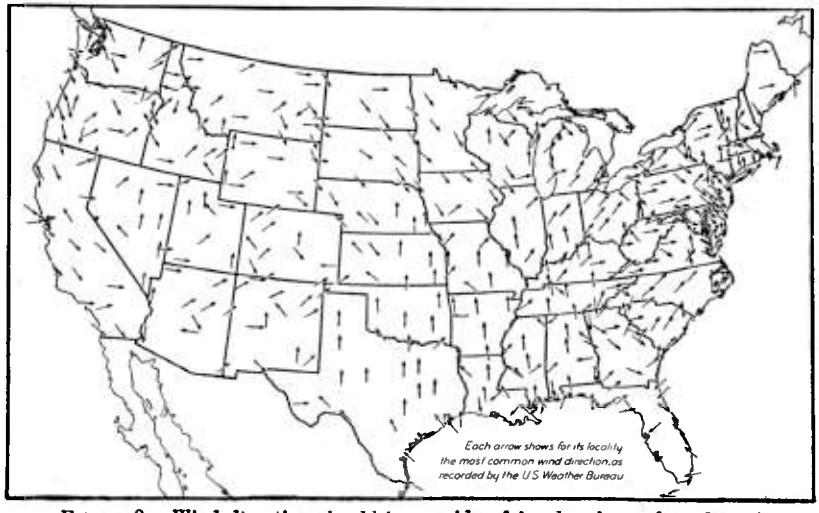

FIGURE 2.—Wind direction should be considered in planning a farm layout

The prevailing wind directions in all parts of the United States are indicated in Figure 2. The arrows indicate, for their respective localities, only the wind direction that prevails to a greater extent

than does any other. In many cases, the second most common wind direction is from the point of the compass opposite that representing the most common or prevailing direction. If the farm layout, therefore, is so planned that the line connecting the main buildings is approximately at right angles to the line of the more common wind directions, the occasions when the wind blows either from the barn to the dwelling or from the dwelling to the barn will be relatively infrequent. It is impracticable, in this bulletin to give complete information on the wind directions for all localities, but more complete information may easily be obtained. The United States Weather Bureau maintains section centers or regional head offices to which the local stations send their data for further compilation and analysis. These section centers are located at the capitals of the respective States except as indicated in the accompanying list.

State	Weather Bureau section center
California	San Francisco
Delaware	Baltimore
Florida	Jacksonville
Kentucky	Louisville
Louisiana	New Orleans
Maryland	Baltimore
Minnesota	Minneapolis
Mississippi	Vicksburg
Nevada	Reno
New England (all six States)	Boston
New York	Ithaca
Oregon	Portland
Pennsylvania	Philadelphia
South Dakota	Huron
Texas	Houston
Washington	Seattle
West Virginia	Parkersburg
Wisconsin	Milwaukee

By addressing the United States Weather Bureau Office at the capital city of the State, or, for the States listed, at the city named, anyone can obtain more complete information on the wind directions for his locality, including not only the direction of the prevailing wind but the percentage of the time that the wind comes from each of the commonly recognized points of the compass.

Roofing material.—The kind of roofing material to be used is of particular importance in the construction of dwellings on the farm, as elsewhere. Other buildings may shelter animals and other valuable property. The dwelling shelters the family. Heating apparatus is an essential part of the home, and effective spark arresters are not generally found on farm dwellings. It is probable, therefore, that at times sparks will fall on the roof. Failure to keep the chimney clear of accumulations of soot adds greatly to this danger. Especially on days of high wind and strong draft these soot accumulations are likely to ignite and temporarily transform the chimney into a roaring furnace. In any case, should fire originate in some other building, the roof of the dwelling may be exposed to flying brands.

A substantial roof of tile, slate, metal, or other noncombustible, fire-resistant or fire-retardant roof covering of the better grades, requires a somewhat greater initial cost than one consisting of wooden shingles or of thin roll roofings, but it adds materially to safety from fire. It also lessens the possibility of flying brands that might set fire to near-by buildings in case fire originates in the dwelling.

If wooden shingles are to be used, poor grades should be avoided, especially for dwelling roofs, and the best grades of edge-grained shingles should be insisted upon. Flimsy and cheap grades of

manufactured roofing should be avoided even though they may be found more or less fire resistant while they are in good condition. For all varieties of roofing material, the cost per year of service rather than the initial cost is the final test of economy. The danger that chimney sparks, or brands from a near-by fire, may ignite a roof that is covered with dry wooden shingles is greatly increased when the shingles are old, frayed, and warped. Roofs of other material when in poor repair also increase the danger of fire. Such dilapidated roofs on dwellings should be replaced or recovered not only to give renewed weather protection, but to remove a special fire hazard.

Fire stopping.—In the construction of walls of the dwelling fire stopping should be given due consideration. By fire stopping is meant particularly the closing of all open spaces in hollow walls at the floor line so that fire will not pass quickly from the basement to the house above, or from one story to another. The added cost of this precaution in the construction of a dwelling is small in comparison with the added fire safety that it gives.

Chimney construction.—The construction of the chimney deserves special attention, and under no circumstances should the avoidance of minor expense in the construction of this feature be permitted to make the home a fire trap. For safety in chimney construction, substantial masonry is necessary, and this should, without exception, rest firmly upon the ground and not on brackets or on any part of the building, unless a substantial cellar wall be considered such a part.

Chimneys disintegrate most quickly at the top, owing to the combined action of weather and hot gases. Lime mortar in the joints and soft brick are soon affected with the result that wide cracks are formed, permitting the passage of sparks. Such a condition is frequently found in old chimneys to a point well below the roof and constitutes a source of great danger. Minor cracks may be filled with good cement mortar, but if there are many cracks or if the bricks are eaten away the chimney should be torn down to solid construction and rebuilt with hard-burned brick and good cement mortar. A crack in a chimney may be located by building a smudge in the fireplace and covering the chimney with a board or wet sack. Escaping smoke will then quickly reveal any existing crack or cracks in the chimney walls. All new chimneys should be built with sound thick walls and preferably should be lined with fireclay flue lining. No woodwork should be built into or in direct contact with the masonry of any chimney. Defective chimneys are one of the most frequent causes of fires in dwelling houses.

Open stairways are a source of danger in that, when a fire has started in the cellar or lower floor of a house, they may act as chimneys and may soon become impassable. Loss of life in farmhouse fires is often the result of this condition, the victims being trapped on an upper floor. A second stairway in another part of the house may mean the difference between life and death.

Barn fires are generally caused by carelessness, lightning, or spontaneous ignition. Many of the precautions recommended for dwelling construction apply to barns also; the least that should be done is to provide a heavy floor over the stock, if hay is stored above, to

prevent rapid burning through, should the hay be ignited. This will increase the opportunity to save valuable stock. All hay chutes and stairways should be closed lest a fire below spread rapidly to the hay above or burning hay from the mow drop into the stable below.

The specific suggestions regarding fire-protective construction on the farm, given in Farmers' Bulletin No. 1590, which cover chimneys as well as all other parts, should prove of much value whenever important alterations are to be made or new buildings are to be erected. A copy of this bulletin may be had free if a request is addressed to the United States Department of Agriculture.

Lightning protection.—Protection against lightning is important, as lightning is one of the more frequent causes of fire in farm buildings, in most parts of the United States. Excepting possibly a few localities in the Far West and especially in the Pacific Coast States, where the lightning hazard is unusually slight, no farm building of substantial value should be considered actually completed until it has a standard system of protection against lightning. Individuals can still be found who question the value of protection from lightning by means of a system of grounded conductors or by the proper grounding of substantial metal roofs, but the evidence of the value of such protection leaves no reasonable room for doubt.

The lightning-protection system should be inspected at least once a year, and particular attention should be given to the rods at the points at which they enter the ground. It is here that corrosion of the metal or down conductors is most likely to occur. Mechanical injury to the rods also most frequently occurs at or near the ground.

All who have looked with some care into the question of the value of protection from lightning agree that, when applied according to accepted modern methods and standards, it possesses a high degree of efficiency. This efficiency has been calculated as ranging from about 85 per cent to 98 or 99 per cent, the higher figures applying to systems that comply with present standards. A 98 per cent efficiency in this case means that the probability of loss or damage from lightning is so reduced by the protective system that only two cases of damage from lightning actually occur to protected buildings for each hundred cases of damage that occur to the same number of unprotected buildings under the same general conditions.

More detailed information regarding the value of lightning protection and methods of providing such protection is found in Farmers' Bulletin No. 1512, which may be had free, as long as the supply lasts, if a request is addressed to the United States Department of Agriculture.

Electrical installations.—Electrical installations constitute serious fire hazards unless care is used in installing the wiring, motors, and devices, and in the proper handling of the equipment. The wiring of buildings should be properly performed; otherwise a ground or short circuit may be the means of starting a fire. One of the most serious fire hazards is the use of improvised fuses or fuses of too great amperage. Open wiring should never be used in farm buildings in which flammable material is stored, as the wires are exposed and the insulation may become worn or may be gnawed by rats or mice, causing grounds or short circuits, which are likely to cause

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fires. All wiring should be inclosed in conduits or other approved protective covering, and all joints should be made mechanically and electrically secure in fireproof boxes, and should be as well insulated as is the wire.

Motors and generators that have commutators or slip rings and brushes or other parts that are liable to arc during operation (that is, where the electric current may jump from one part to another) should be kept out of locations where the arcing may ignite flammable material. Switches should be kept out of such locations, and knife switches should always be installed in metal boxes. Motor starters that are liable to arc and rheostats that are likely to attain high temperatures should be kept out of rooms containing flammable material. Transformers should never be located against walls of buildings, especially wooden buildings, but should be at a safe distance, so that burning oil from the transformer will not cause a fire hazard. Rheostats and other resistance devices should always be considered as sources of heat, which are liable to become red hot and from which drops of molten or heated metal may fall or spatter to some distance. The fire and personal hazard can be avoided only by installing resistance devices with this possibility in mind.

Where there is considerable outdoor wiring, line lightning arresters should be installed to protect the buildings from fire and to protect the motors and electrical devices from burnouts.

The National Electrical Code covers interior wiring in detail. All wiring and appliances should be installed in compliance with it, and in accordance with any additional requirements that the local electric company may have. The code is a set of rules that have been the standard of practice for many years covering electrical installations from the viewpoint of fire hazard. It is revised from time to time by the electrical committee of the National Fire Protection Association. All electric wiring should be done by an experienced electrician who is familiar with the requirements of the National Electrical Code.

Many disastrous fires have been started by the careless handling of flatirons, curling irons, and similar devices. When left standing with the current on, such devices become excessively hot and may ignite wood or other flammable material. Some flatirons are provided with a thermostatic cut-out that acts to break the electric circuit when the temperature of the iron has reached some predetermined point.

HAZARDS AND DANGERS FROM CARELESSNESS

A very large percentage of farm fires are due to carelessness in the placing and in the use of heating and lighting equipment. Thousands of farm homes and hundreds of lives are lost each year because of lack of care and forethought in the selection, installation, placement, and operation of stoves, lamps, and other heating and lighting apparatus.

Stoves and furnaces.—Stoves and furnaces should be put up solidly and should be so placed that the heat from them can not ignite near-by walls or woodwork of any kind. If the room is such that it does not permit placing the stove at sufficient distance from the walls to avoid danger to exposed woodwork, the wall should be

covered with sheets of metal or asbestos. A substantial metal or asbestos covering should also be placed under the stove, and this protective covering should extend well out beyond the edge of the stove, particularly on the side containing the door to the fire box, from which burning embers are likely to fall.

Stoves or furnaces should be of such size that sufficient heat can be generated to keep the home at the proper temperature even in cold weather without crowding or overheating them. This precaution adds greatly to the life of the apparatus as well as to the fire safety of the dwelling.

Stoves and pipes, as well as chimneys, should be cleaned from time to time by the removal of all accumulations of soot. In the absence of any better device for sweeping the chimney, a bundle of twigs or of branches of evergreen tied to a rope will be found relatively effective. Even a bundle of coarse hay, the wisps of which are well twisted together, makes a usable brush for sweeping the chimney. Specially constructed wire-brush chimney cleaners have also been devised.

Stovepipes.—Stovepipes should enter directly into the chimney without passing through walls or partitions. If a house is so constructed that the chimney can not be reached without passing the stovepipe through a wall except at considerable expense, a ventilating thimble should be provided. This thimble, which may be obtained at almost any hardware store and fitted into the wall or the floor, greatly reduces the danger of fire from an overheated pipe, since air circulates through the open spaces in the thimble on all sides of the pipe and carries off the heat to a considerable extent. Metal smoke pipes should not pass through floors, closets, or other concealed spaces. Such practice often results in fires that are not discovered until they have gained serious headway.

Fireplaces.—Open fireplaces are favored by many because of their cheerful effect. Unprotected fireplaces may involve a considerable danger, however, especially in homes in which there are small children. Besides the danger from flying sparks, clothing may be set afire by too near an approach to the flames, and children at play may fall into the fire. A substantial screen is always necessary before a fireplace which is in use, to avoid danger to the furnishings as well as to persons.

Oil stoves.—Oil stoves for cooking purposes, and sometimes for heating purposes, are found in farm homes. Most of these stoves burn kerosene, but others are constructed for burning gasoline. Oil stoves are dangerous unless used with due care, and those burning gasoline require even greater precaution than those in which kerosene is used.

Lamps.—Oil lamps will probably continue for some time as the most common source of light on the farm, notwithstanding a constant increase in the number of farm homes provided with more modern lighting systems. All oil lamps intended to stand on tables or desks should, for the sake of safety, have a relatively wide base so that they will not easily be tipped over. A metal lamp has an advantage over a glass lamp in that if it should be accidentally tipped over or dropped to the floor, it will not break, and so is not likely to involve flooding the room with burning oil. Gasoline lamps are

occasionally used; they involve added possibility of serious accidents unless handled with special precaution and care.

All oil lamps, as well as oil stoves, should be filled by daylight and, even then, care should be taken that the filling is done well away from a heated stove or a flame of any kind. The term "filling lamps" does not convey the exact meaning. The oil chamber should never be poured so full that there is not ample room for the slight expansion of the oil that results from the heat generated by the lighted wick. If the lamp is so full that the oil extends almost up to the flame the expansion may cause an overflow of burning liquid that endangers the family as well as the house. Lamps should never be placed on rickety boxes or stands but only on solid tables or furniture suitable for the purpose. Furthermore, they should be placed well away from the edge of the supporting surface, so that the danger of their being tipped over and thrown to the floor is remote.

Kerosene to quicken fire.—The use of kerosene to kindle or quicken fires in stoves or furnaces has been the cause of many of the most distressing accidents. If the stove is still warm from the last fire, or if a smoldering fire is in the stove at the time kerosene is poured on, the danger of accident is particularly great. The reports of the State fire marshals abound in concrete and often gruesome warnings against the use of kerosene to quicken fires.

Gasoline.—Although the use of gasoline in lamps or stoves may not be increasing since there is a growing use of electricity, improved kerosene-using devices, and other factors, the use of this powerful oil product for other purposes is becoming more and more common with the increase in the number of automobiles, tractors, and gasoline engines. With proper care, gasoline can be safely handled, but the nature and explosive power of the vapor from this liquid should be kept in mind wherever and whenever it is used. Gasoline in large quantities, outside of special storage areas, should be stored only in underground tanks from which it is pumped as needed. To store gasoline on the premises in other ways involves considerable possibility of accident, and if practiced the dangers should be fully recognized and guarded against by every practicable safety measure. It is unwise and reckless to store gasoline inside any farm buildings. The vapors from this liquid are heavier than air and tend to form first along the floor. A room may contain considerable gasoline vapor before it becomes perceptible to a person in the room; a flame or a spark may cause an explosion before the vapor is noticed. No open flame of any kind should be permitted near by when gasoline is being handled or poured. All portable containers for gasoline should be painted a bright red and should be distinctly labeled "Gasoline."

Acetylene.—Acetylene generated in private plants is used on a considerable number of farms. If the plant and fixtures are properly constructed, installed, and cared for, acetylene is as safe as other recognized means of providing light for the farm and heat for cooking purposes. But this form of gas, which is generated by placing calcium carbide in contact with water, is highly explosive when mixed with a certain quantity of air. The carbide, stored for future use in the generator, must be kept perfectly dry and must be kept in a well-ventilated place. No flame of any kind should be

brought near the generator; should a leak in the system be suspected, it should never be searched for by the use of any form of light with a flame.

Incubators and brooders.—Incubators and brooders carry an element of danger. The fact that they are left burning unattended for long periods makes the danger of accidental fire greater than in the case of oil-burning equipment in the home. The barn is usually one of the worst places to operate these oil-burning devices. If possible, they should be operated in some smaller detached building or shed where, if fire does occur, the loss may be held to a minimum.

Gasoline for cleaning purposes.—The use of gasoline for cleaning purposes involves serious hazards. Many fatal accidents have resulted from this practice. In the open air, the vapor from the gasoline will diffuse rather promptly and lose much of its explosive nature. Indoors the danger is particularly great, because the vapor from open gasoline containers, or from garments saturated with this liquid, is confined and may cause a destructive explosion if a spark or flame of any kind comes in contact with it. The mere rubbing of silk fabric may produce a spark and ignite gasoline vapors. The use of benzene or naphtha for cleaning purposes must be placed in the same hazardous class of practices. Many safe cleaning fluids are available which will neither explode nor burn. The safe practice is to use only such noncombustible cleaning fluids.

Matches.—Matches represent one of the greatest conveniences of civilized man, but their very convenience and the ease with which fire may be produced any time and any where lead to many accidents and destructive fires. Matches are especially dangerous in the hands of children and constitute a serious menace to them as well as to property.

The double-tipped parlor match, which can be recognized by its head of two colors, is considerably safer than the ordinary parlor match, because ignition can take place only when friction strikes the end of the match head. Such a match is rarely ignited by being stepped upon or crushed.

The match that involves the least danger of accidental fire is, however, the well-made safety match that will ignite only when rubbed upon the specially prepared surface of the sides of the box. Such matches never ignite because accidentally stepped upon or crushed. Unless match stems are made of straight and firm wood, there is danger that the stem will break when the match is struck, and that the burning head will set fire to clothing or other material upon which it falls. Particularly on farms, it seems advisable to use only good grades of matches which can be ignited only when struck on the box. Any other kind may conceivably cause a fire by being dropped accidentally in hay and litter and becoming ignited by friction caused in some unexpected way.

Regardless of the kind of matches used, they should be so stored or placed as to be out of reach of small children. Near the stove or other place where matches are regularly used, a metal or glass receptable for the partially burned match stems should be provided. Throwing supposedly dead matches into the waste-paper basket or the wood box has caused many fires.

Careless smokers.—The careless smoker with his matches is often as great a danger to property as is a child with matches. This danger consists not only in the voluntary lighting of matches and throwing them away before they are completely extinguished but in the accidental dropping of matches in dry hay or litter where they may later ignite by being stepped upon or by friction caused in other ways. The unextinguished cigar butt and particularly the cigarette butt, thrown away while still burning, constitute a serious fire menace. They have been responsible for numerous fires in buildings as well as in forests and fields when grass and leaves are dry. Smoking in or about the barn, or other outbuildings that contain combustible material, should not be tolerated. The result may be a scene such as that shown in Figure 3.

FIGURE 3.—A barn fire spreads rapidly and, unless extinguished before it has a real start, the building is likely to be doomed

Disposal of ashes.—The careless disposal of ashes from stoves or furnaces in active use has caused many farm fires. Even when the ashes recently shaken from the fire box appear to be dead, they may contain live coals which a wind may scatter among dry grass or litter and fan into a flame. Unless metal cans or receptacles are available for the disposal of ashes, care should be taken to see that they are actually dead before they are thrown out and left unguarded. This is particularly important in dry seasons. Safety as well as considerations of neatness suggests that loose ashes should never be dumped near the house.

Accumulation of rubbish.—Needless accumulation of rubbish in attics, cellars, or other storage places add to the fire hazard of the building in which they occur. They not only aid the spread of a fire and hinder its prompt extinction, but they may be directly responsible for starting a fire if oily rags capable of self-ignition are

present among the rubbish, or if matches should be accidentally dropped and later ignited among the trash. The easiest way to dispose of most kinds of rubbish is to pile it at some distance from the house and set fire to the pile. But in so doing due care must be exercised to see that buildings and other property are not endangered. Such fires should never be started on a windy day. Even on a still day the fire should be watched, not only until the blaze ceases but until all smoldering embers are dead.

Christmas trees.—Christmas trees, usually associated only with happiness and good will, have, through thoughtlessness and carelessness, in many instances brought disaster and sorrow. Burning candles on Christmas trees should not be permitted; and even if candles are not used, the decorations should consist of tinsel or other noncombustible material; they should not be made of paper, cotton, or similar flammable material that adds seriously to the fire hazards of the home.

Storage of hay.—The storage of hay or other fodder in barns before it is well dried has caused many barn fires through heating and spontaneous ignition. Clover, alfalfa, and similar kinds of hay with heavy stems that retain considerable moisture after the thinner leaves appear to be dry are considered especially dangerous in this respect. Naturally, this danger is most common when the haying season happens to be rainy and the proper curing and drying of the hay is made difficult, if not impossible. At such a time, the risk of losing the crop or a part of it in the field may have to be weighted against the danger of losing the barn as well as the crop by storing the hay in an uncured and damp condition. The first of these alternatives would normally seem the lesser evil. If the remaining moisture in the hay is not too great, the danger of spontaneous ignition may be lessened by salting the hay during the process of storing. Three to ten pounds of salt per ton of hay, depending on the degree of dampness, will retard fermentation and may prevent spontaneous ignition. But too much reliance should not be placed on this safeguard, and it is not a substitute for proper curing and drying before storage. The spontaneous combustion of hay is discussed in Technical Bulletin 141 of the United States Department of Agriculture.

HOME FIRE-FIGHTING EQUIPMENT

To be of real value, home fire-fighting equipment must be kept in a handy place and kept in condition for instant use. The successful use depends upon early discovery of the fire.

LADDERS

Numerous roof fires are caused by sparks from the top of the chimney or openings in its sides. A ready means of reaching the top of a roof has saved many a building. The results shown in Figure 4 might have been avoided had the dwelling been provided with ladders. The appearance of buildings is sometimes marred by attaching fire ladders, but in many instances the ground ladder can be located inconspicuously and the roof ladder may be merely a narrow board having a few small cleats. In lieu of attached ladders it is well to have two light, strong, portable ladders, one of which has

a large hook for hooking over the ridge pole. Householders should be sure ladders are in the best of repair. Fighting fire from ladders and roofs involves enough danger without taking the risk of using defective ladders.

FIRE PAILS AND BARRELS

Many small farm fires are extinguished with the use of a few pails, pans, or dippers of water. The water should be thrown so as to drench the burning material. If directed towards the top of the flame most of the water is likely to be wasted.

Fire pails are usually of wood, fiber, or galvanized steel, and they usually hold about 12 quarts. It is a good plan to paint the outside of the pails red and stencil "For fire only" on them in large black letters. Flat-bottom and cone-bottom pails are in use, but the latter are favored because they do not stand alone and therefore are less

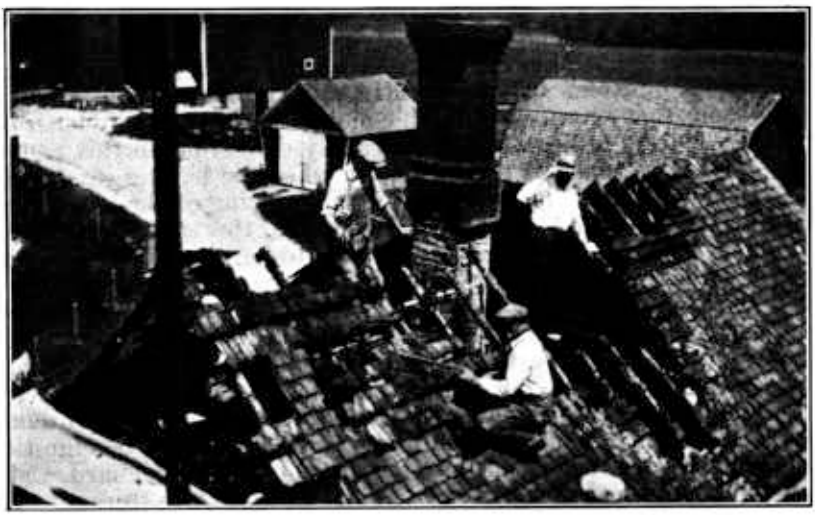

FIGURE 4.—A total loss from chimney sparks on the roof was averted by the timely aid of neighbors with simple home fire-fighting equipment

likely to be used for other purposes. One pail to each 400 or 500 square feet of area served is generally sufficient. The pails should be hung from hooks or brackets or set on shelves 2 to 4 feet from the floor.

The main shortcomings of pail protection are the tendency to use the pails for other purposes, failure to have them always filled, the limiting of the water reserve to the relatively few pails that can be kept on hand, and difficulty or impossibility of reaching fire within flues, partitions, or walls, or on high ceilings, or roofs. Minor disadvantages relate to evaporation, freezing, or stagnation of the water and unsightliness of the pails. Tight, but easily removable covers or lids will lessen evaporation, and 3 to 6 pounds of common salt or calcium chloride dissolved in each pail will usually prevent freezing. A brine of this strength will retard or prevent objectionable odors and the breeding of mosquitoes. If it is not strong enough and if

the water will never be used for other than fire-prevention purposes, a small quantity of copper sulphate, either powdered or in crystals, may be dissolved in the water. A heaping teaspoonful thoroughly dissolved in 50 gallons of water should be sufficient.

Storage of water in casks, barrels, or tanks adds much to the value of pails for fire fighting. Old oil barrels, pork barrels, or cider barrels holding 50 to 60 gallons are suitable. Much that has been stated regarding fire pails applies to other fire reserve containers.

WATER UNDER PRESSURE

Numerous small fires have been extinguished by prompt use of a hand force pump and a piece of hose. A power-driven pump discharging into a good-size hydropneumatic tank from which water is piped to the buildings is, or should be, of still greater value. Roofs, cornices, ceilings, and other spots upon which water could not be thrown with pails can sometimes be wet down sufficiently with a jet from a hose.

The reader is cautioned not to be over sanguine as to the value of small, pressure water systems for fighting fire. To fight a well-ignited fire successfully requires more water and higher pressure than ordinarily is obtained with farm water systems. With 57 pounds pressure at the sill cock, 50 feet of ¾-inch rubber hose, and an ordinary $\frac{3}{16}$-inch nozzle, the discharge is 7½ gallons per minute—less than three pailfuls. Such a stream directed at a large fire avails little, on account of its dispersion by heat, and it may happen that no water reaches the desired point. Other practical difficulties relate to frozen pipe lines, shortage or defects in the hose, misplaced nozzles, and lack of experience in the skillful use of the equipment when the time comes to fight fire. Although farm water systems are not generally given credit in insurance ratings, they may be of great value if a fire be discovered in its incipient stage, and it undoubtedly is wise, when a pressure system is installed, to provide a few well-placed hose connections. Farmers' Bulletin 1448, Farmstead Water Supply, describes in detail the installation of farm water systems.

CHEMICAL EXTINGUISHERS

Soda-acid type.—Various types of chemical extinguishers are among the special fire-fighting devices that are highly useful on the farm as well as in mercantile or manufacturing establishments. The most common of these types is a 2½-gallon soda-acid extinguisher. Such extinguishers are usually so made that they can be hung on a wall in any convenient place. Turning the extinguisher upside down from the position in which it hangs causes the soda solution and acid to mix, resulting in the formation of carbon-dioxide gas, the pressure from which expels the solution through the hose. The stream from this extinguisher has force to carry a distance of 30 to 40 feet and the flow continues for about one minute. If directed at the seat of a fire that has not attained serious headway, the stream from such an extinguisher is usually sufficient to put out the fire.

Larger soda-acid extinguishers mounted on wheels are in use in many small towns and villages. They should prove worth-while

equipment on larger farms or estates. These larger extinguishers can be mounted on a rig that forms a convenient trailer to an automobile. In this form they can be conveyed rapidly to assist in extinguishing a fire at a considerable distance.

In winter all soda-acid extinguishers must be placed where the temperature remains above freezing. Salt or other antifreezing ingredients should not be added to the soda-acid type of extinguisher.

Pump-tank type.—A fire extinguisher equivalent in effect to the soda-acid type, but which will not freeze except at very low temperatures, is the pump-tank extinguisher, the usual sizes having capacities of 2½ or 5 gallons. The extinguishing agent is water to which calcium chloride has been added to depress the freezing point. This solution can be expelled by means of the pump to a distance of 30 to 40 feet, which gives these extinguishers about the same range as the soda-acid type.

Carbon tetrachloride hand-pump type.—Another common form of commercial extinguisher is the carbon tetrachloride hand-pump type. The usual sizes are of 1-quart or 1½-quart capacity. This is not a general-purpose extinguisher, but it is effective if the heavy gas generated by the liquid can form a blanket over the fire that will smother the flames. The liquid is forced out by working the pump with one hand while holding the extinguisher with the other. The stream can be thrown a distance of about 20 feet, and the liquid can be expelled at the rate of a quart in 40 to 50 seconds.

The carbon tetrachloride extinguisher, like the calcium chloride pump-tank extinguisher, has the advantage over the soda-acid type in that it does not freeze under ordinary winter temperatures. In fact it requires a temperature of about −50° F. to cause the special liquid furnished with this extinguisher to congeal. In recharging these extinguishers no liquid other than the special extinguishing liquid furnished by the manufacturer should be used. Ordinary chemical carbon tetrachloride will not serve, as its freezing point has not been depressed and it corrodes the mechanism of the extinguisher.

Under the heat of the fire the carbon tetrachloride mixture vaporizes very rapidly. The vapor formed as soon as the liquid hits the fire is heavy and noncombustible, and in effect smothers the fire by shutting off the oxygen. The fumes generated in fighting fires with carbon tetrachloride extinguishing liquid are intensely irritating and may be dangerous to the operator in confined or poorly ventilated spaces.

Water or the soda-acid mixture has but little effect on oil fires since these liquids are heavier than oil and do not vaporize. The burning oil floats on the surface of the liquid thrown upon it and continues to burn.

Foam type.—Another form of chemical fire-fighting equipment is the foam extinguisher. The most common size is of 2½-gallon capacity. Turning the extinguisher upside down from the position in which it hangs causes two separately contained chemical solutions to mix. Carbon dioxide gas is formed, the pressure of which expels from the extinguisher a foam of countless small bubbles filled with carbon dioxide gas. This foam is directed to cover the burning surface and smothers the flames. The foam can be thrown a distance of from 20 to 30 feet for about one minute. Like the soda-acid type

of extinguisher, the foam extinguisher must be protected against freezing, but antifreezing ingredients should not be mixed with the solutions to depress their freezing point.

Each type of extinguisher described has its particular field of usefulness. Soda-acid extinguishers are effective on incipient fires in ordinary combustible materials, such as wood, paper, textiles, and rubbish; that is, in cases in which the quenching and cooling effect of quantities of water or of solutions containing large percentages of water is of first importance. They are not effective on fires in flammable liquids, greases, etc., where a blanketing extinguishing effect is essential. Carbon tetrachloride extinguishers are effective on fires in electrical equipment and on small quantities of flammable liquids and greases, where the gas formed by the heating of the extinguishing liquid can be retained as a blanket on the burning material. They are particularly suitable for use on automobiles. They are not effective on fires on which the quenching and cooling effect of water is of first importance. Foam extinguishers are effective not only on incipent fires where the quenching and cooling effect is important, but also on fires in flammable liquids and greases where the blanketing effect is essential.

Sand, soil, and sawdust.—Common sand and soil and even sawdust have been found useful in many instances in extinguishing small fires, such as oil burning on floors. Anyone of these substances tends to smother the fire by shutting off the oxygen. Obviously, to put out a fire with these materials (particularly in the case of sawdust which, if lightly applied, literally adds fuel to the flame) a heavy blanket of the material must be quickly applied. This method of protection against fire should be supplemented with other first-aid extinguishing devices.

Various types of commercial fire extinguishers are on the market, which for one reason or another have not gained the approval of recognized fire-protection agencies. A brief description of a few of these appliances intended for home use, with some indication of the shortcomings of each, will be found in the following paragraphs.

Dry-powder devices.—A so-called dry-powder extinguisher consisting of a tube of paper or metal filled with finely divided inert material, such as brick dust to which has been added some bicarbonate of soda to prevent caking, has been used to some extent in various localities. When thrown upon the fire, this material will under certain conditions smother and extinguish the flame. The quantity of powder in these extinguishers is necessarily small, and in the excitement of discovering a fire, there is considerable danger that little if any of the powder will reach the seat of the fire. Furthermore, unless the limitations of this type of extinguisher are understood, the owner or user will have a false sense of security against fire.

Hand grenades.—Extinguishers described as hand grenades have also been sold. These consist of glass bulbs containing a liquid, generally carbon tetrachloride, or powder. The plan is to throw the closed bulb at the fire causing the glass container to break and release the contents on the fire. These hand grenades, like the dry-powder extinguishers, involve various chances of failure to get the

extinguishing material released at the point intended. There is considerable chance that by inexperienced throwers they will be sent wide of the mark, and there is the further possibility that unless they hit a hard surface, they may fail to break and release the extinguishing material. An automatic feature is provided for one brand of grenade extinguisher by hanging the bulb in a bracket which releases it at a temperature of 130 ° F. or some other designated point. Upon being released from the bracket the glass bulb drops to the floor and breaks, thus pouring out the fire-extinguishing agent. The bulb can also be taken from the bracket and thrown at a fire like the ordinary hand-grenade extinguisher.

Partly because of their low cost, some of these extinguishers have been favored by individuals and groups of individuals. But neither dry-powder (tube) extinguishers nor any of the forms of hand grenade or bulb extinguishers have succeeded in obtaining recognition from the leading fire-protection engineers or organizations of the country.

COMMUNITY FIRE PROTECTION

To bring out more clearly the relation of the third and final fire safeguard, community fire protection, to the other two, let it be assumed that in a certain farm community the suggestions already given have been adopted and followed in a practical way. In other words, let it be assumed that in this community all farmers give reasonable attention to the elimination of fire hazards in the construction and maintenance of their buildings, and exercise reasonable care in the selection and handling of equipment and material used in connection with household fires. Let it be assumed further that each farmhouse in this community is supplied with certain simple fire-fighting equipment which is readily at hand in designated places and with which a fire can be promptly reached and extinguished before it has attained seriously destructive proportions.

In such a farm community the average annual fire loss will be small. Accidental fires will occur only rarely, and of those that do occur a substantial percentage will be extinguished before serious loss takes place. Absolute perfection in individual safeguards has not been assumed, but only such conditions as it would be humanly possible to attain with economic and other factors as they are. It is reasonably certain that even in such a community some fires will occur, and occasionally one of these fires will fail to be discovered until it is beyond control by any ordinary home fire-protection equipment. To the victim of such an occurrence it is slight comfort to know that this seldom happens in his community. What he wants and needs is help in putting out the fire, or at least in keeping it from spreading to other buildings or property.

Hence, even in such a community the need for organized rural fire protection will exist. How much more pronounced, then, is the need for such organized protection in the more typical farm community in which fire prevention and home fire-fighting equipment are given only meager attention?

A rural fire department may not be able in many cases, to save the building in which fire breaks out, particularly if this building happens to be the barn. It will, however, in most cases prevent the

fire from destroying other buildings and property on the place and will thereby substantially lessen the loss that otherwise would occur. Under favorable conditions even the dwelling or other building in which the fire originated may be saved from extensive damage.

The practice of providing organized rural fire protection under some plan or other has been spreading rapidly in recent years. About 15 years ago the few pioneer communities that were trying out a plan of this kind began to attract attention in fire-protection circles. To-day such rural communities are numbered by the hundreds or even by the thousands, if all communities and groups are included which have informal arrangements or some form of organized and specially equipped fire protection service.

Complete information on farm fire departments or service is not available, but the following general statement is based on information supplied largely by State fire marshals or insurance commissioners.

In Maine a substantial part of the rural homes and communities now have fire protection from near-by city or village departments that have been provided with special fire-fighting equipment for rural use.

In many communities, particularly in the State of New York, local mutual fire insurance companies have contributed toward fire equipment for departments in near-by towns in order that the members of these insurance companies may have fire protection.

In eastern Pennsylvania, notable progress has been made in providing fire protection for rural communities from cities, boroughs, and towns, and in a number of counties some of the townships have cooperated in the purchase of fire-fighting equipment. Lancaster County alone has 41 fire companies in unincorporated towns and villages, besides 23 larger organizations in incorporated places. These companies operate a total of 85 fire trucks with pumpers, or chemical outfits, or combinations of both. In other Eastern States, and more especially in Maryland and Rhode Island, considerable progress has been made in safeguarding rural property by local arrangements for fire protection.

In the States of the Middle West, Michigan may be said to be one of the leaders in organized fire protection for farmers. According to the 1928 report by the fire marshal division of the Michigan Department of Insurance, 200 rural fire trucks are in operation in that State. They are usually stationed in cities or villages and are manned by members of paid or voluntary fire companies. Ohio, Indiana, Illinois, Wisconsin, Iowa, and Minnesota all show encouraging development in organized rural fire protection.

Among the far Western States, California stands out as a leader in this movement. During the period of the recent World War a substantial part of the State was organized on a county and community basis into rural fire-protection districts. A total of about 400 local companies are said to have been organized by the end of 1918. Following the close of the war, lack of further progress in this movement, as well as of failure to hold the ground already gained, became evident. Recently, however, there has been a revival of interest in this problem. In 1928, 42 rural fire companies were either organized for the first time or reorganized, and at least

183 such companies, distributed among 20 counties, were in operation during the year.

The California rural fire-protection companies have in most cases differed materially from those in the Eastern or Middle Western States in purpose as well as in organization and equipment. The main function of the California companies has been to fight range, forest, and field fires during the dry summer season that usually prevails in extensive sections of that State, and the fighting of fires in farm buildings has hitherto been an incidental rather than a primary object.

The use of the so-called combine, the machine which reaps and threshes grain in a single operation, has been common for many years in the larger grain sections of the Pacific Coast States. This method of gathering the grain naturally increases the danger of field fires, even aside from any fire hazards connected with the machine itself or the tractor by which it may be drawn. Obviously, leaving the standing grain until it is dry enough to thresh properly means that any fire that gets into such a grain field is likely to cause a serious loss unless promptly discovered and extinguished. The recent extension of the use of the combine in the wheat States of the Middle West and even further east means that here too fire protection for grainfields will be needed to a greater degree than under the older harvesting methods.

RURAL FIRE TRUCKS

Equipment used by fire departments for rural service must necessarily differ from that intended exclusively for urban use. The typical city fire apparatus is not adapted for use on rural roads, or for fire fighting on the farm where, in most cases, only very small quantities of water are available. For country use lighter apparatus is needed; reliance must be placed upon moderate-sized trucks equipped with pumps or chemical tanks, or both, and carrying the necessary hose lines, ladders, hand chemical extinguishers, water buckets, and other equipment.

Suggested standards for such rural fire trucks and equipment have been outlined in a recent report on rural fire departments, by the National Fire Protection Association, with headquarters at 60 Batterymarch Street, Boston, Mass. This report was prepared by the committee on farm fire protection, which is working under the auspices of the association, with David J. Price, of the Bureau of Chemistry and Soils, United States Department of Agriculture, as chairman. A copy of the report may be obtained either from the association or from the chairman of the committee on farm fire protection.

The purchase, maintenance, and operation of rural fire equipment is being financed in a number of ways. In perhaps a majority of instances the money has been raised by voluntary subscriptions partly from the farmers concerned and partly from public-spirited business men in the cities and villages at which the apparatus is stationed and whose paid or voluntary fire company provides the necessary fire-fighting force. In other instances the cost is met wholly or in part from public sources such as township, county, or municipal funds, by means of loans or directly by the proceeds from tax levies.

These sources of funds are often supplemented with money raised by local carnivals, fairs, and other social enterprises. A smaller town or village may profit by cooperation with groups of farmers or with townships as much as do the farmers who obtain protection by such cooperation. The fire department of the town or village is likely to be better equipped and therefore more efficient than it would be without such cooperation.

LAWS ENCOURAGING ORGANIZED RURAL FIRE PROTECTION

In a number of States laws have been enacted for the purpose of encouraging and promoting organized rural fire protection. These laws permit townships, or districts organized specifically for fire protection, to appropriate money, levy taxes, and in some instances to issue bonds, either to purchase fire-protection equipment and provide for its maintenance and use, or to contract for such service from cities, towns, or villages. The States having such laws include California, Illinois, Indiana, Iowa, Michigan, Minnesota, New York, Ohio, Oregon, Pennsylvania, and Wisconsin.

On the basis of the nature of the legislation on this subject these 11 States may be divided into two groups. The laws of the larger of these groups, which includes 7 States, provide for an enlargement of the powers of township governments to include the right to provide fire protection under stipulated conditions. The laws of the other group, which include California, Illinois, New York, and Oregon, authorize the organization of special rural fire-protection districts without reference to township borders.

The laws in the States of the first group, which have what may be called the township plan, differ from one another in various respects. Although they all authorize the expenditures of township funds for the purpose of fire protection, in some cases this can be done only as a result of a vote of the township electors, and in other cases the power is vested more directly in the township officers. The amount that may be expended for this purpose in any one year is usually limited, and the choice of organizing and equipping their own fire departments, or of contributing to the equipment and support of an existing city, town, or village department which agrees to provide rural fire-protection service, is usually left with the township. The limit to expenditures for new equipment in any one year is usually $5,000 or $6,000, and the amount that may be expended for upkeep and use varies, in so far as it is stipulated, from $1,000 to $2,500. The former amount covers the average cost of a well-constructed and equipped rural fire truck. Some of these laws provide not only that townships may cooperate with incorporated places for this purpose, but also that two or more townships may cooperate with one another in establishing, equipping, and maintaining fire-protection organizations.

The States which authorize the formation of rural fire-protection districts naturally have somewhat more elaborate legal provisions since in these cases it was necessary to set up a procedure for the incorporation and organization of these districts as well as to provide for their management. In the four States with laws of this kind, fire-protection districts may come into existence only as the result of a vote or a petition representing the major part either of

the voters or of the property affected by the proposed action. Under the laws of California and New York the actual incorporating of such districts is done by the county supervisors, whereas in Illinois and Oregon the county judge of the county in which all or a major part of the proposed district is located takes charge of the election and appoints a board of trustees to manage the fire-protection district.

In most of the 11 States the laws here considered have been either enacted or materially amended during the last few years. Their final value or significance can not therefore be determined at this time. It seems highly desirable, however, that organized rural fire protection should be encouraged and promoted by giving townships or other rural units an opportunity to provide for such protection wholly or in part through existing governmental machinery.

CONCLUSIONS

No practical application of fire safeguards either by the individual or by the community, or by both combined, will entirely eliminate the possibility of loss by fire. But the probability of such loss occurring to a given farm home can be greatly lessened, and the aggregate of the annual losses for any larger group or for all American farm homes can be greatly reduced from its present total. This should mean correspondingly reduced cost of insurance protection against such few losses as may nevertheless occur and correspondingly greater personal safety to the farmer and his family.

The burning of a farm building worth $2,400 means to an owner who has no insurance that he himself loses that amount. To the wiser owner of such a building, who has his property insured to the usual extent of about three-fourths of its value, such an occurrence means that the insurance company loses about $1,800 and he himself the remaining $600. In addition, as in the case of the uninsured owner, he suffers the inconvenience or loss of being without the building until it can be replaced. Regardless of whether the property was insured the Nation is poorer by the $2,400 represented by the building burned unless a part of the insurance was carried in a foreign insurance company. In the latter case it would still be true that mankind is poorer by the full amount of the loss.

Insurance is indispensable to the individual who wishes to play safe. But insurance does not create wealth to replace that which is lost. It merely distributes the loss, or a greater part of it, over a larger or smaller group of individuals. It is no real substitute for fire prevention and fire protection either from the point of view of the honest insured or from that of civilized society. This general truth applies to farmers quite as much as to any other economic group. Reasonable fire safeguards for the farm in the form of proper fire prevention measures, simple but effective home fire-fighting equipment, and organized rural fire protection, are essential to rural progress and safety.

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